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ABSTRACT

Research on brain hemisphere functions appears to indicate that (1) lateralization occurs from about age five to puberty; (2) both hemispheres are involved in language learning in ways not yet fully understood; (3) after age fifteen, pronunciation learning becomes difficult; (4) older language learners learn more quickly, but younger learners reach the same proficiency level; and (5) each hemisphere does a difficult job. Scientists generally agree that the left hemisphere controls language in about 95% of right-handed and two-thirds of left-handed people. There is much speculation as to each hemisphere's specialty, and while their functions differ, both use high-level cognitive modes. There is a close working relationship between the hemispheres. Perhaps too much time has been spent trying to identify students' lateral dominance. What's more important is to become aware of the right brain's capability and respect intuition and nonverbal thinking more. Some language teaching techniques do this. Right-brain stimulation will reinforce learning and enhance student experience. The brain's information-processing capacity can be improved through enriched environments, good health habits, and mental challenges. These research findings have implications for revision of language teaching and learning, curriculum, textbooks, and materials. A 52-item bibliography is included. (MSE)

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10 Implications of Brain Hemisphere Research for Second Language Teaching And Learning

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One hears much about the brain, but how does the organ work?

There are anywhere from ten to one hundred billion neurons or cells in the brain, but no one really knows their function; they are unpredictable. However, both Kornhuber (1974) and Pribram (1971) found that willed intent was programmed throughout the brain, but, for Restak (1985), it is difficult to understand a concept that appears to be at the same time localized and in both hemispheres of the brain. It is a mystery.

This brings up the question as to how the brain handles two languages as opposed to one language. Albert and Obler (1978) wrote that "knowledge of multiple languages has anatomical consequences" which, according to some researchers, "may find expression in specifically bilingual strategies for language processing, perhaps even differing perceptions of the universe" (cited in Benderly, 1981, p. 9).

Ojemann & Whitaker found that "within the center of the language area of each subject (in their study) there appeared to be sites common to both languages (English—Spanish and English—Dutch bilinguals)" but "peripheral to this... are sites with differential organization of the two languages. There is a tendency for those sites concerned with a given language to cluster together." (cited in Benderly, p. 10). They speculated that perhaps learning an L2 takes "a large number of neurons located over a wide area" and that with growing familiarity, this number may shrink.

For the bilingual, every linguistic situation is a choice, every possibility has a twin in the background.

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Vaid and Lambert (1979) find that bilinguals appear to be more able to distinguish among auditory and visual stimuli, e.g., their greater ability to distinguish figure from ground (i.e., to pick an object in a picture out of its background). They believe that bilinguals are "more field-independent" (cited in Benderly, p. 10).

It seems to them that very early bilinguals use left hemisphere strategies to understanding while later bilinguals use those more closely related to the right hemisphere. They add that "early childhood bilinguals analyze works at the level of meaning..." while "later bilinguals seem to judge more on the basis of physical features of the words, like melody or combination of sounds" (cited in Benderly, 1981, p. 10).

Ben-Zeev writes that early bilinguals (infancy or early childhood) have "been confronted early in life with a verbal environment of unusual complexity, in which underlying order is difficult to discover because the rules belong to two structures, not one. Result: they seem to have developed special facility for seeking out rules and for determining which are required by the circumstances" (cited in Benderly, p. 10).

She found that elementary school pupils fluent in both Hebrew and English were quicker and subtler when analyzing verbal material and more adept at seeking out the underlying dimensions of the patterns they confront" (cited in Benderly, p. 10). Studies are suggesting that multilingual children stabilize their lateralization for language earlier than other children.

Language involves the process of (a) receiving and understanding messages, and (b) sending messages. However, different languages might present quite different sorts of stimuli and different languages show more left brain involvement, others more right brain involvement.

Some researchers assert that the order of learning does not have a differentiating effect; others believe the opposite, e.g., Ten Houten et al. suggest "that socially subordinate individuals generally show greater right-hemisphere involvement" (cited in Benderly, p. 12). Yet others report that bilinguals generally appear to process both their languages on the same side.

For Obler (1980), it now appears that "particularly in the early stages of language learning there's more right hemisphere involvement than you'd expect" (cited in Benderly, p. 9), and the right hemisphere remains surprisingly important even after an L2 is completely mastered.

Because of psychological factors and differences in learning situations, individuals vary in the time it takes to attain a given level of

proficiency; they also fossilize in their second language at different levels and for different reasons. This suggests that more attention must be given to individual language experiences, if the recency of acquisition hypothesis is to be verified.

Research indicates that "foreign accents cannot be overcome easily after puberty" and that "automatic acquisition (of second languages) from mere exposure...seems to disappear after this age" (Lenneberg, 1967, p. 176).

Krashen (1981) states that, at formal operations, the adolescent becomes an abstract thinker and is able to "reflect on the rules he possesses and on his thoughts (*Developmental Psychology Today,* 1971, p. 336), and can "deal with problems in which many factors operate at the same time" (Elkind, 1979, p. 66).

In de Lorenzo's (1980) study investigating whether Mexican Americans have a different cerebral specialization for native language than for second language as measured by visual shift, it was found that, when the students answered in English, they shifted to the right while they shifted to the left when answering in Spanish. If there is a different cerebral arrangement for each language, there are implications for FL teaching: the relation between cerebral arrangement and cognitive style entails considerations concerning methods of instruction, grouping, reward systems, and assessment.

In most normal children growth occurs rapidly during perhaps a six-month period some time between the ages 2 and 4, 6 and 8, 10 and 12 plus, and 14 and 16 plus (Sylwester, 1982, p. 89). During each growth period the brain creates and insulates the neural extensions and connections needed to perform new cognitive functions.

"Reading, writing, speaking and problem solving involve activity in the angular gyrus (an area of the left hemisphere)—as do show-and-tell time, manipulative arithmetic, field trips, and other activities that involve the combining of sensory data" (p. 92).

It is well to remember that in the 10-12 year growth period brain growth of girls is three times that of boys. Periods of nongrowth are consolidation periods for both sexes. Since there is growth during the summer, what are the implications for individualizing instruction, reading readiness, instruction as related to cognitive levels?

Taylor (1978) and Seliger (1978) discuss critical periods based on the maturation of the brain, and each period is ready for the acquisition of one aspect of language. Brown and Jaffe (1975) feel that

lateralization is a continuing process of specialization. Seliger (1978) says:

> Because localization does not take place at once, but affects different aspects of language at different periods of life, one would expect a different timetable to evolve in terms of different language abilities. That is, there would be many critical periods, successive and perhaps overlapping, lasting probably throughout one's lifetime, each closing off different acquisition abilities. This may explain why phonology is acquired beyond the age five cutoff for lateralization but not much beyond the onset of puberty in most cases, and why other aspects of the language system, at least in some form, are acquirable throughout most of life. (p. 16)

The critical period hypothesis has been questioned and several studies show that older learners are more proficient at second language learning and that their cognitive maturity is an asset. (Ausubel, 1964; Taylor, 1974).

There is much to learn about the brain, how it works, and its implications, but the literature and research, although contradictory in many respects, seem to indicate that (a) lateralization takes place anywhere from about age five to puberty; (b) both hemispheres are involved in the learning of languages, but there is no consensus as to the exact role of each, especially that of the right hemisphere; (c) it is difficult to learn the accent of a new language after about age fifteen; (d) older learners are quicker language learners, but younger learners come to equal their proficiency; and (e) each hemisphere does a difficult job. For the latter, Krashen, (1981) comes up with the following:

Table 1

FUNCTIONS OF THE TWO HEMISPHERES

Left Hemisphere	Right Hemisphere
Language	Spatial relations
Time-related functions	"Gestalt" perception Part-to-whole judgments
"Propositional" thought	Music
	"Appositional" thought (p. 70)

Genesee's (1982) experimental evidence suggests that there may be greater right hemisphere involvement in the bilingual's language processing when acquiring the second language late relative to the L1 and also in bilinguals who learn their L2 in informal contexts.

Among scientists there appears to be general agreement that the left half of the brain controls language in about 95 percent of the right-handed people and about two-thirds of all left-handed people (Finn, 1983). For the remainder of the people, claims, counter-claims, theories, and hunches (Douglass, p. 24).

There is much speculation as to what each hemisphere specializes in, usually described as modes of consciousness, contrasting qualities, or styles. Each has special thinking characteristics. They don't approach life in the same way, yet both hemispheres use high-level cognitive modes.

Table 2

CONTRASTING QUALITIES

Rational Convergent Sequential Logical Analytic	Lawyer A Student	Metaphoric Divergent Random Intuitive Synthetic	Free-spirited artist
Field Independent Works more on his own More competitive Keeps certain distance from teacher		Field Dependent Likes to work with others More sensitive to feelings and opinions Closer to the teacher	
Western Tendency to be active, To try to influence the environment, To take charge		Eastern More receptive to environment	
Linear Part-to-whole		Holistic Involves the whole picture first	
Symbolic Letters & numbers (essential in L2 learning)		Concrete Direct experiences (doing, feeling, moving)	
Verbal Words		Visuospatial Images and spatial awareness	

Source: Douglass, 1984, p. 24.

Research has shown that (a) the hemispheres each represent a separate consciousness, (b) there is lateralization of functions, and (c) there is plasticity of the brain.

There is a close working relationship between the halves since the hemisphere best suited to the task at hand takes over smoothly.

In other words, it appears that each hemisphere has special talents and therefore the one best qualified to answer a question takes charge. Most people switch between the two, but there are some who leave such a degree of lateralization that they may use the wrong half, thus, may have the right answers but will not be able to state how they arrive at them.

Frankly, the distinction between the two is far from resolved, as each person seems to show only a preference in the style used.

My thinking, along with many others, is that we perhaps have been spending too much time attempting to identify right-versus left-trained students, which is a difficult task; why not, as Douglass (1984) postulates, "try to make our teaching methods more right-brained in approach.... This would mean tapping the intuitive, creative, affective aspect of every learner, regardless of so-called dominance. A complete education should stress aesthetic/synthetic thinking as well as verbal/analytic thinking." (p. 26)

Our task is to become more aware of the capability of the right brain and come to respect intuition and nonverbal thinking more. Suggestopedia and the TPR tap the right brain. Visualization must be encouraged as it is an excellent means to expand memory (vocabulary learning). Good results are being had through the use of songs, dances, poetry (Douglass, p. 26).

I do believe that if the right brain is stimulated, it will reinforce learning and provide the student with a variety of experiences from which to draw. Finally, the more we recognize the many ways suggested as legitimate forms of learning, there will be better and more learning.

When Roger Sperry, a recent Nobel prizewinner, discovered about how the brain works may affect our conduct in the teaching of foreign languages, more than that, it may influence us to rewrite our textbooks, and that is "that although both hemispheres of the brain appear to be almost identical in structure, different areas of the brain seem to be specialized to do particular things...each hemisphere is an independent brain that speaks a different language. It is as if one hemisphere speaks English and the other can communicate only in the sign language of the deaf." (Asher, 1982, p. 8)

The literature shows some general agreement that the right hemisphere seems to prefer an intuitive kind of thinking, which leads to

an early conclusion without going through the steps of the left hemisphere; it does not get bogged down, which frequently leads the individual to something creative as in art, drama, music.

Guiora et al. (1983), in their research, found a correlation between the measure of hemisphere efficiency and approximation of native-like pronunciation. Further, the right hemispheric activity can predict the quality of pronunciation in a foreign language.

The right hemisphere seems to perceive the world with essential different emotional views than the left; it also appears to add its own emotional dimension transposing what is perceived as something more horrible and more unpleasant than reality (S. J. Dimond, Linda Farrington, and Peter Johnson (1976), pp. 690-92).

There is some evidence that it may be able to process concrete nouns (White, 1961; Basser, 1962, Krashen, 1973; Dennis and Kohn, 1975; Dennis and Whitaker, 1976; Dennis, 1980) and has the capacity to comprehend concrete nouns (Obler, 1980; Krashen and Scarcella, 1978).

Dennis suggests that "the process by which words become attached to visual arrays is mediated...perhaps more efficiently by the right (cited in Schneiderman and Wesche, 1983, p. 170).

It appears that the language-related capacities of the right hemisphere do play, at least initially, an important role in L1 acquisition; after this, it may be called on in special circumstances, such as serious left hemisphere damage or acquiring another language (Schneiderman and Wesche, 1983, p. 164).

"That the right hemisphere may indeed be essential to second language acquisition is...supported by a study of individuals with intact first language skills and high verbal IQs who suffered severe damage restricted to the right hemisphere in early childhood. These individuals later experienced severe difficulties in acquiring a second language" (H. Teuber and R. Rudel, cited in Obler, 1980).

Since youngsters have recently utilized the right hemisphere language acquisition strategies, it seems likely that they resort to them for performing certain second language tasks.

Wonder and Donovan (1984) list some of the right hemisphere skills: intuitive, spontaneous, emotional, nonverbal, visual, artistic, wholistic, playful, diffuse, symbolic, physical, factors which are nondominant, but "cultures that give preference to mystical, intuitive, intangible, and artistic values would be right dominant" (p. 160).

So, the right brain shows its capability in a rather wide range of performance ability and more adept with certain functions as opposed to others. Zaidel (1973) reports that:

1. Right hemisphere comprehension is considerably superior to right hemisphere speech.
2. The right hemisphere possesses an understanding of certain semantic relations.
3. At the word level, the right hemisphere possesses a surprisingly rich auditory comprehension lexicon, especially of high frequency concrete items, although it can deal with more abstract words to some extent.
4. Right hemisphere phonetic and syntactic abilities, however, appear to be quite inferior to the left hemisphere.
5. The right hemisphere does, however, have some degree of syntactic competence. Although inferior to the left, the right hemisphere can comprehend a variety of syntactic classes, including verbs, can perform some transformations, and can understand some grammatical relations. (cited in Galloway and Krashen, 1980, p. 75)

Zaidel further states that "right hemisphere syntactic comprehension is optimal in contextually rich and semantically redundant situations. In general, right hemisphere linguistic performance deteriorates and is seriously impaired relative to left hemisphere performance when stimulus complexity is introduced by such factors as abstractness, length, word order, lack of redundancy, and decreasing frequency, and when excessive demands are placed on detailed analysis and the apparent limited short-term visual and auditory memory of the right hemisphere" (cited in Galloway and Krashen, 1980, p. 78).

The human brain with its limitless capacity and potential as an information processor can be taught ways to improve it. For example, young children's mental development dramatically increased by enriching environments. It is also suggested that a well-balanced diet, exercise, and mental challenges are the best way to get the most from your brain.

Wonder and Donovan (1984) suggest left to right activities such as the following:

1. Doodling, drawing, printing
2. Singing rounds, humming, recalling, joking, and chuckling
3. Daydreaming
4. Making eye contact with others to feel their point of view
5. Relating to someone or something you know or have experienced
6. Being aware of the colors, space, aromas, sounds, emotions around you
7. Seeing the whole situation, how each person and element is related (p. 163).

In summary, much research has been done on the brain and many of its findings are seen as inconclusive, especially as related to L2 learning. The result is that there is still much unknown, therefore, much further research is needed. However, it can be said that there is some general thinking that the left hemisphere is more active in the language area and that the right hemisphere may be somewhat involved, but there is no consensus as to the exact role of each. The result has been much speculation as to the functions and contrastive qualities of each hemisphere as is evidenced by the many lists which have appeared in various publications.

Research findings on the right and left hemisphere of the brain and their capability to do specialized things or to complement each other should have, if properly utilized, an impact on and strong implications for a new, revised look at language teaching and learning as well as curriculum, textbooks, and materials.

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